Claims

[c1] We claim:

1. A system of communicating for an injection system for use within a magnetic resonance imaging (MRI) suite, said MRI suite having a scanner room, a control room and a barrier separating said scanner and said control rooms, said system comprising:

(a) a first transceiver situated within said scanner room in an injection control unit of said injection system;

(b) a second transceiver situated within said control room in a controller of said injection system;

(c) a first antenna positioned within said scanner room approximate an interior side of said barrier, said first antenna being capable of receiving from and transmitting to said first transceiver; and

(d) a second antenna positioned within said control room approximate an exterior side of said barrier, said second antenna being capable of receiving from and transmitting to said second transceiver;

wherein said first and said second antennas are interconnected through said barrier to form an antenna coupling thus enabling said controller and said injection control unit to communicate therethrough across said barrier using a desired range of radio frequencies outside a range of, and without adversely affecting, operation of said MRI suite.

[c2] 2. The system claimed in claim 1 wherein said antenna coupling further comprises a filter connected between said first and said second antennas to prevent radio frequencies outside of said desired range from being transmitted across said barrier.

[c3] 3. The system claimed in claim 2 wherein said filter is one of a highpass filter, a bandpass filter, and a bandstop filter at a Larmor frequency of a main magnet in said scanner room.

[c4] 4. The system claimed in claim 1 wherein said first and said second antennas employ a circularly polarized design.

[c5] 5. The system claimed in claim 1 wherein said first and said second antennas

are directive antennas.

[c6] 6. The system claimed in claim 1 wherein said first and said second antennas are broadband antennas to allow for communication at several radio frequencies within said desired range.

[c7] 7. The system claimed in claim 1 wherein said desired range of said radio frequencies is at least approximately double a Larmor frequency of a main magnet in said scanner room.

[c8] 8. The system claimed in claim 1 further comprising at least one signal repeater positioned within said scanner room for relaying communications between said first antenna and said first transceiver.

[c9] 9. The system claimed in claim 1 further comprising a plurality of signal repeaters positioned within said scanner room for relaying communications between said first antenna and said first transceiver.

[c10] 10. The system claimed in claim 1 further comprising an amplifier connected between at least one of (i) said first antenna and said second antenna on said exterior side of said barrier and (ii) said first antenna and said second antenna on said interior side of said barrier.

[c11] 11. The system claimed in claim 1 wherein at least one of said first and said second transceivers employs a filter to prevent radio frequencies outside of said desired range from being transmitted.

[c12] 12. An antenna coupling for communicating across a barrier to radio frequencies, said antenna coupling comprising:
(a) a first antenna adapted to be positioned on a first side of said barrier, said first antenna being capable of receiving from and transmitting to a first transceiver disposed on said first side of said barrier; and
(b) a second antenna adapted to be positioned on a second side of said barrier, said second antenna being capable of receiving from and transmitting to a second transceiver disposed on said second side of said barrier;
said first and said second antennas being interconnected through said barrier to

form said antenna coupling and thereby enable said first and said second transceivers to communicate therethrough across said barrier over a desired range of said radio frequencies.

[c13] 13. The antenna coupling claimed in claim 12 further comprising a filter interconnected between said first and said second antennas to prevent radio frequencies outside of said desired range from being transmitted across said barrier.

[c14] 14. The antenna coupling claimed in claim 13 wherein:
(a) said filter is a microstrip filter sandwiched insulatively between conductive layers;
(b) said first antenna is a patch antenna interconnected to one end of said microstrip filter and capable of being positioned on said first side of said barrier; and
(c) said second antenna is a patch antenna interconnected to the other end of said microstrip filter and capable of being positioned on said second side of said barrier.

[c15] 15. The antenna coupling claimed in claim 14 wherein one of said conductive layers of said antenna coupling is adapted to be grounded and affixed to at least one of a jamb and an edge of a door of said barrier with said first and said second antennas being situated on said first and said second sides of said barrier, respectively.

[c16] 16. The antenna coupling claimed in claim 14 wherein said antenna coupling has a bracket-shaped configuration with said first and said second patch antennas connected at a predetermined angle at opposite ends of said microstrip filter.

[c17] 17. The antenna coupling claimed in claim 12 wherein said antenna coupling is adapted to be affixed to an entry way through said barrier with said first and said second antennas being situated on said first and said second sides of said barrier, respectively.

[c18] 18. The antenna coupling claimed in claim 13 wherein said filter is

interconnected between said first and said second antennas so as to be positioned on said second side of said barrier.

[c19] 19. The antenna coupling claimed in claim 13 wherein said filter is one of a highpass filter, a bandpass filter, and a bandstop filter at a Larmor frequency of a main magnet in an MRI suite.

[c20] 20. The antenna coupling claimed in claim 12 wherein said first and said second antennas employ a circularly polarized design.

[c21] 21. The antenna coupling claimed in claim 12 wherein said first and said second antennas are directive antennas.

[c22] 22. The antenna coupling claimed in claim 12 wherein said first and said second antennas are broadband antennas to allow for communication at several radio frequencies within said desired range.

[c23] 23. The antenna coupling claimed in claim 12 wherein said desired range of said radio frequencies is at least approximately double a Larmor frequency of a main magnet in an MRI suite.

[c24] 24. The antenna coupling claimed in claim 12 further comprising an amplifier connected between at least one of (i) said first antenna and said second antenna on said first side of said barrier and (ii) said first antenna and said second antenna on said second side of said barrier.

[c25] 25. An antenna coupling for communicating across a barrier to radio frequencies, said antenna coupling comprising:
(a) a first antenna positioned on a first side of said barrier;
(b) a second antenna positioned on a second side of said barrier, said first and said second antennas interconnected through said barrier to enable a desired range of said radio frequencies to be transmissible through said barrier via said first and said second antennas; and
(c) a filter connected between said first and said second antennas to prevent radio frequencies outside of said desired range from being transmitted across said barrier.

[c26] 26. A system of communicating for use within a magnetic resonance imaging (MRI) suite, said MRI suite having a scanner room, a control room and a barrier separating said scanner and said control rooms, said system comprising:
(a) a first transceiver situated within said scanner room associated with a first piece of equipment;
(b) a second transceiver situated within said control room associated with a second piece of equipment;
(c) a first antenna positioned within said scanner room approximate an interior side of said barrier, said first antenna being capable of receiving from and transmitting to said first transceiver; and
(d) a second antenna positioned within said control room approximate an exterior side of said barrier, said second antenna being capable of receiving from and transmitting to said second transceiver;
wherein said first and said second antennas are interconnected through said barrier to form an antenna coupling thus enabling said first and said second pieces of equipment to communicate therethrough across said barrier using a desired range of radio frequencies outside a range of, and without adversely affecting, operation of said MRI suite.

[c27] 27. The system claimed in claim 26 wherein said antenna coupling further comprises a filter connected between said first and said second antennas to prevent radio frequencies outside of said desired range from being transmitted across said barrier.

[c28] 28. The system claimed in claim 26 wherein said first and said second pieces of equipment are an injection control unit and a controller therefor, respectively, of an injection system.

[c29] 29. The system claimed in claim 26 wherein at least one of said first and said second transceivers employs a filter to prevent radio frequencies outside of said desired range from being transmitted.

[c30] 30. A method of communicating across an isolation barrier separating a scanner room and a control room of a magnetic resonance imaging (MRI) suite, said method comprising the steps of:

(a) positioning a first transceiver within said scanner room;

(b) positioning a second transceiver within said control room;

(c) interconnecting a first antenna and a second antenna;

(d) positioning said first and said second antennas within said MRI suite such that (i) said first antenna is positioned within said scanner room approximate an interior side of said isolation barrier and is capable of receiving from and transmitting to said first transceiver and (ii) said second antenna is positioned within said control room approximate an exterior side of said isolation barrier and is capable of receiving from and transmitting to said second transceiver; and

(e) configuring said first and said second transceivers to use a desired range of radio frequencies outside a range of operation of said MRI suite in communicating across said isolation barrier via said first and said second antennas, and thus avoiding adverse affects upon an operation of a scanner in said MRI suite.

[c31] 31. The method claimed in claim 30 further comprising the step of connecting a filter between said first and said second antennas to prevent radio frequencies outside of said desired range from being transmitted across said isolation barrier.

[c32] 32. The method claimed in claim 30 wherein said first and said second transceivers are associated with and allow communication between an injection control unit and a controller therefor, respectively, of an injection system.

[c33] 33. A system for communicating across an isolation barrier separating a scanner room and a control room of a magnetic resonance imaging (MRI) suite, said MRI suite for accommodating a plurality of bifurcated equipment systems, each of said bifurcated equipment systems having an interior portion for placement within said scanner room and an exterior portion for placement within said control room, said system comprising:

(a) a first antenna positioned within said scanner room, said first antenna being capable of receiving from and transmitting to a plurality of interior transceivers situated within said scanner room, each of said interior transceivers being

associated with said interior portion of one of said bifurcated equipment systems corresponding thereto; and

(b) a second antenna positioned within said control room and interconnected to said first antenna through said isolation barrier to form an antenna coupling therewith; said second antenna being capable of receiving from and transmitting to a plurality of exterior transceivers situated within said control room, each of said exterior transceivers being associated with said exterior portion of one of said bifurcated equipment systems corresponding thereto; each of said exterior transceivers and said interior transceiver corresponding thereto forming a transceiver pair for one of said bifurcated equipment systems through which said interior and said exterior portions thereof communicate through said antenna coupling across said isolation barrier using a desired range of radio frequencies assigned thereto outside a range of, and without adversely affecting, operation of said MRI suite.

[c34] 34. The system claimed in claim 33 wherein said antenna coupling further comprises a filter connected between said first and said second antennas to prevent radio frequencies outside of all of said desired ranges of said transceiver pairs from being transmitted across said isolation barrier.

[c35] 35. The system claimed in claim 34 wherein said filter is one of a highpass filter, a bandpass filter, and a bandstop filter at a Larmor frequency of a main magnet in said scanner room.

[c36] 36. The system claimed in claim 33 wherein said first and said second antennas employ a circularly polarized design.

[c37] 37. The system claimed in claim 33 wherein said first and said second antennas are directive antennas.

[c38] 38. The system claimed in claim 33 wherein said desired ranges of said radio frequencies of said transceiver pairs are at least approximately double a Larmor frequency of a main magnet in said scanner room.

[c39] 39. The system claimed in claim 33 wherein:

(a) said filter is a microstrip filter sandwiched insulatively between conductive

layers;

(b) said first antenna is a patch antenna interconnected to one end of said microstrip filter and capable of being positioned on an interior side of said isolation barrier; and

(c) said second antenna is a patch antenna interconnected to the other end of said microstrip filter and capable of being positioned on an exterior side of said isolation barrier.

[c40] 40. The system claimed in claim 39 wherein one of said conductive layers of said antenna coupling is adapted to be grounded and affixed to at least one of a jamb and an edge of a door of said barrier with said first and said second antennas being situated on said first and said second sides of said barrier, respectively.

[c41] 41. The system claimed in claim 39 wherein said antenna coupling has a bracket-shaped configuration with said first and said second patch antennas connected at a predetermined angle at opposite ends of said microstrip filter.

[c42] 42. The system claimed in claim 33 further comprising at least one signal repeater positioned within said scanner room for relaying communications between said first antenna and said first transceiver.

[c43] 43. The system claimed in claim 33 further comprising a plurality of signal repeaters positioned within said scanner room for relaying communications between said first antenna and said first transceiver.

[c44] 44. The system claimed in claim 33 further comprising an amplifier connected between at least one of (i) said first and said second antennas and positioned within said scanner room and (ii) said first and said second antennas and positioned within said control room.

[c45] 45. The system claimed in claim 33 wherein at least one of said interior and said exterior transceivers employs a filter to prevent radio frequencies outside of said desired range(s) from being transmitted.

[c46] 46. An antenna coupling for communicating across a barrier to radio

frequencies, said antenna coupling comprising:

(a) a plurality of interior antennas each of which adapted to be positioned on an interior side of said barrier, each of said interior antennas being capable of receiving from and transmitting to at least one interior transceiver disposed on said interior side of said barrier; and

(b) a plurality of exterior antennas each of which adapted to be positioned on an exterior side of said barrier, each of said exterior antennas being capable of receiving from and transmitting to at least one exterior transceiver disposed on said exterior side of said barrier, each of said interior transceivers and said exterior transceiver corresponding thereto forming a transceiver pair;

each of said interior antennas and said exterior antenna corresponding thereto being interconnected through said barrier to form an antenna pair for enabling said transceiver pair(s) corresponding thereto to communicate therethrough across said barrier over a desired range of said radio frequencies.

[c47] 47. The antenna coupling claimed in claim 46 further comprising a filter interconnected between said first and said second antennas of each of said antenna pairs to prevent radio frequencies outside of said desired range from being transmitted across said barrier.

[c48] 48. The antenna coupling claimed in claim 46 further comprising a filter interconnected within at least one of said antenna pairs to prevent radio frequencies outside of said desired range from being transmitted across said barrier.